

CLAIMS

1. A powder filling device comprising:

a measuring tank having a powder discharge port and  
5 a filling amount control unit disposed near the powder  
discharge port; and

an auxiliary container having an opening disposed  
on an underside of the powder discharge port of the measuring  
tank which faces downward,

10 wherein a powder externally delivered into the  
measuring tank is discharged from the powder discharge port  
into a powder filling container disposed on an underside of  
the auxiliary container while a filling amount of the powder  
is controlled by the filling amount control unit, and the  
15 powder is temporarily dropped to the auxiliary container, and  
further dropped to the powder filling container so that the  
powder filling container is filled up with the powder.

2. The powder filling device according to claim 1

20 wherein the auxiliary container is of a conical funnel-like  
type, and is arranged so that a tubular body part of the  
auxiliary container having an outlet is inserted into an  
opening of the powder filling container.

25 3. The powder filling device according to claim 2

wherein an angle of a conical top part of the auxiliary container is in a range of 50 to 70 degrees.

4. The powder filling device according to claim 1  
5 wherein the powder filling device further comprises a rising/falling unit provided for moving up and down the auxiliary container.

5. The powder filling device according to claim 1  
10 wherein the filling amount control unit is provided with at least three filling amount control functions of free powder discharging, powder discharge stopping, and partial powder discharging.

15 6. The powder filling device according to claim 1 wherein the measuring tank is formed with a cylinder body which extends from a position where the filling amount control unit is disposed to a position of the powder discharge port.

20 7. The powder filling device according to claim 1 wherein the filling amount control unit comprises an elastic body ring fixed to the powder discharge port of the measuring tank, and a discharge control unit which controls discharging of the powder from the powder discharge port,

25 wherein the discharge control unit comprises a

discharge amount control member which is mounted on a discharge control lever which is moved up and down within the measuring tank, and

wherein the discharge amount control member  
5 comprises a conical-shape member which opens and closes the powder discharge port by separation of the conical-shape member from the powder discharge port and insertion of the conical-shape member to the powder discharge port.

10 8. The powder filling device according to claim 7 wherein a degree of opening/closing of the powder discharge port is adjusted by a degree of insertion of the conical-shape member to an opening of the elastic body ring which depends on a degree of an up/down movement of the discharge control lever  
15 within the measuring tank.

9. The powder filling device according to claim 1 wherein the filling amount control unit is made of a filter material which passes a gas and does not pass the powder, and  
20 the powder is drawn to the filter material by using a gas suction unit communicating with the filling amount control unit, so that the filling amount of the powder is controlled according to a degree of suction of the powder by the gas suction unit.

10. The powder filling device according to claim 9 wherein the filling amount control unit is provided so that the filter material is fixed to close a through hole formed in a tubular body part of the auxiliary container, and a wall  
5 which does not have a gas leakage is provided around an outside of the filter material so that a space part is formed.

11. The powder filling device according to claim 9 wherein the filter material is formed in a twill weave.  
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12. The powder filling device according to claim 1 wherein a powder fluidization hopper which is connected with the measuring tank is provided, and, after the powder in the powder fluidization hopper is delivered to the measuring tank  
15 temporarily, the powder in the measuring tank is delivered to the powder filling container.

13. The powder filling device according to claim 12 wherein a powder outlet of the powder fluidization hopper and  
20 a powder inlet of the measuring tank communicate with each other through a connecting tube.

14. The powder filling device according to claim 12 wherein the powder fluidization hopper comprises an inclined  
25 inside wall portion, and the powder inside the powder

fluidization hopper is sent to the powder outlet by the inclined inside wall portion.

15. The powder filling device according to claim 12  
5 wherein the powder fluidization hopper comprises a powder fluidization unit, and the powder in the powder fluidization hopper is fluidized with a gas sent from the powder fluidization unit, and the fluidized powder is sent to the measuring tank.

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16. The powder filling device according to claim 15  
wherein the powder fluidization unit is provided with a gas introducing pipe attached thereto, and the gas introducing pipe introduces a pressurized gas to a porous body which has a  
15 number of fine holes for spouting a gas, and the fine holes communicate with each other inside the porous body.

17. The powder filling device according to claim 15  
wherein a plurality of powder fluidization units are provided,  
20 and each powder fluidization unit is provided with a gas introducing pipe attached thereto.

18. The powder filling device according to claim 14  
wherein the powder fluidization unit is disposed at the  
25 inclined inside wall portion.

19. The powder filling device according to claim 13 wherein the connecting tube has a downward inclination such that the powder fluidized with the gas sent from the gas  
5 introducing pipe is delivered from the powder fluidization hopper to the measuring tank through the connecting tube.

20. The powder filling device according to claim 12 wherein at least one of the powder fluidization hopper and the  
10 measuring tank is provided with a pressure control unit which controls an internal pressure of the at least one of the powder fluidization hopper and the measuring tank.

21. The powder filling device according to claim 1  
15 wherein a filling powder weight managing unit is provided for managing the filling amount of the powder to the powder filling container.

22. The powder filling device according to claim 21  
20 wherein the filling powder weight managing unit comprises a computation processing unit which computes a filled-up powder weight based on an empty weight of the powder filling container on a load cell and a gross weight of the powder filling container which is filled up with the powder.

23. The powder filling device according to claim 12 wherein a powder feed hopper which supplies the powder to the powder fluidization hopper is provided, and a leading edge of a cylindrical part of the powder feed hopper where the powder is supplied is arranged so that the leading edge is buried in a surface portion of a powder layer of the powder fluidization hopper.

24. A powder filling method which fills up a powder filling container with a powder using a powder filling device comprising a measuring tank having a powder discharge port and a filling amount control unit disposed near the powder discharge port, and an auxiliary container having an opening disposed on an underside of the powder discharge port of the measuring tank which faces downward, the powder filling method comprising:

disposing the powder filling container on an underside of the auxiliary container;

discharging a powder, which is externally delivered into the measuring tank, from the powder discharge port into the powder filling container while a filling amount of the powder is controlled by the filling amount control unit;

temporarily dropping the powder in the auxiliary container so that a gas existing between particles of the powder within the auxiliary container is freely discharged;

and

further dropping the powder in the powder filling container so that the powder filling container is filled up with the powder.

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25. The powder filling method according to claim 24 wherein the filling amount control unit is provided with at least three filling amount control functions of free powder discharging, powder discharge stopping, and partial powder  
10 discharging.

26. The powder filling method according to claim 24 wherein the powder filling device comprises a powder fluidization hopper which is connected with the measuring tank  
15 and has a powder fluidization unit, and the powder in the powder fluidization hopper is fluidized, and the fluidized powder is sent to the measuring tank

27. The powder filling method according to claim 26  
20 wherein an internal pressure of at least one of the powder fluidization hopper and the measuring tank control is controlled during a filling operation of the powder, before the filling operation, and/or after the filling operation.

25 28. The powder filling method according to claim 24



wherein the powder filling device comprises a filling powder weight managing unit which has a computation processing unit, and a filled-up powder weight is computed based on an empty weight of the powder filling container and a gross weight of the powder filling container which is filled up with the powder.

29. The powder filling method according to claim 28 wherein an initial filling weight of the powder is inputted and the inputted initial filling weight is changed by using the computation processing unit.

30. The powder filling method according to claim 24 wherein a powder in a powder fluidization hopper is always made in a fluidized state, a weight of the powder filling container itself is measured, so that a process which disposes the powder filling container on the measuring tank and fills up the powder filling container with the powder of a given amount is repeatedly performed to produce a plurality of powder filling containers each filled up with the powder.

31. The powder filling method according to claim 24 wherein a weight of the whole powder filling container is measured before and after the powder filling, and a filling amount of the powder is regulated by using the filling amount

control unit.

32. A powder filling device comprising:

a measuring tank having a powder discharge port and  
5 a filling amount control unit disposed near the powder  
discharge port; and

an auxiliary container having a gas permutation  
unit disposed on an underside of the powder discharge port of  
the measuring tank which faces downward,

10 wherein a powder externally delivered into the  
measuring tank is discharged from the powder discharge port  
into a powder filling container disposed on an underside of  
the auxiliary container while a filling amount of the powder  
is controlled by the filling amount control unit, and the  
15 powder is temporarily dropped to the auxiliary container, and  
further dropped to the powder filling container so that the  
powder filling container is filled up with the powder.

33. The powder filling device according to claim 32

20 wherein the auxiliary container is of a conical funnel-like  
type, a leading edge of the conical funnel-like auxiliary  
container is provided with a cylindrical body having a powder  
outlet and being inserted into an opening of the powder  
filling container, and a cone bottom of the conical funnel-  
25 like auxiliary container is provided with an opening part in

which the powder discharge port of the measuring tank is inserted.

34. The powder filling device according to claim 33  
5 wherein the gas permutation unit is provided in the conical  
funnel-like auxiliary container, and the gas permutation unit  
comprises a gas ventilating pipe which is disposed and fixed  
to extend from a position near the powder outlet of the  
auxiliary container to an upper part of the auxiliary  
10 container.

35. The powder filling device according to claim 34  
wherein the gas ventilating pipe is formed integrally with the  
auxiliary container.

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36. The powder filling device according to claim 33  
wherein an angle of a conical top part of the auxiliary  
container is in a range of 50 to 70 degrees.

20 37. The powder filling device according to claim 32  
wherein the powder filling device further comprises a  
rising/falling unit provided for moving up and down the  
auxiliary container.

25 38. The powder filling device according to claim 32

wherein the filling amount control unit is provided with at least three filling functions of free powder discharging, powder discharge stopping, and partial powder discharging.

5                   39. The powder filling device according to claim 32 wherein this measuring tank is formed with a tubular body which extends from a position where the filling amount control unit is disposed to a position of the powder discharge port.

10                   40. The powder filling device according to claim 32 wherein the filling amount control unit comprises an elastic body ring fixed to the powder discharge port of the measuring tank, and a discharge control unit which controls discharging of the powder from the powder discharge port,

15                   wherein the discharge control unit comprises a discharge amount control member which is mounted on a discharge control lever which is moved up and down within the measuring tank, and

                  wherein the discharge amount control member  
20 comprises a conical-shape member which opens and closes the powder discharge port by separation of the conical-shape member from the powder discharge port and insertion of the conical-shape member to the powder discharge port.

25                   41. The powder filling device according to claim 40

wherein a degree of opening/closing of the powder discharge port is adjusted by a degree of insertion of the conical-shape member to an opening of the elastic body ring which depends on a degree of an up/down movement of the discharge control lever  
5 within the measuring tank.

42. The powder filling device according to claim 32 wherein the filling amount control unit is made of a filter material which passes a gas and does not pass the powder, and  
10 the powder is drawn to the filter material by using a gas suction unit communicating with the filling amount control unit, so that the filling amount of the powder is controlled according to a degree of suction of the powder by the gas suction unit.

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43. The powder filling device according to claim 42 wherein the filling amount control unit is provided so that the filter material is fixed to close a through hole formed in a tubular body part of the auxiliary container, and a wall  
20 which does not have a gas leakage is provided around an outside of the filter material so that a space part is formed.

44. The powder filling device according to claim 42 wherein the filter material is formed in a twill weave.

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45. The powder filling device according to claim 32 wherein a powder fluidization hopper which is connected with the measuring tank is provided, and, after the powder in the powder fluidization hopper is delivered to the measuring tank temporarily, the powder in the measuring tank is delivered to the powder filling container.

46. The powder filling device according to claim 45 wherein the powder fluidization hopper comprises an inclined inside wall portion, and the powder inside the powder fluidization hopper is sent to the powder outlet by the inclined inside wall portion.

47. The powder filling device according to claim 45 wherein the powder fluidization hopper comprises a powder fluidization unit, and the powder in the powder fluidization hopper is fluidized with a gas sent from the powder fluidization unit, and the fluidized powder is sent to the measuring tank.

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48. The powder filling device according to claim 47 wherein the powder fluidization unit is provided with a gas introducing pipe attached thereto, and the gas introducing pipe introduces a pressurized gas to a porous body which has a number of fine holes for spouting a gas, and the fine holes

communicate with each other inside the porous body.

49. The powder filling device according to claim 47  
wherein the powder fluidization unit is disposed at the  
5 inclined inside wall portion.

50. The powder filling device according to claim 45  
wherein the connecting tube has a downward inclination such  
that the powder fluidized with the gas sent from the gas  
10 introducing pipe is delivered from the powder fluidization  
hipper to the measuring tank through the connecting tube.

51. The powder filling device according to claim 32  
wherein a filling powder weight managing unit is provided for  
15 managing the filling amount of the powder to the powder  
filling container.

52. The powder filling device according to claim 51  
wherein the filling powder weight managing unit comprises a  
20 computation processing unit which computes a filled-up powder  
weight based on an empty weight of the powder filling  
container on a load cell and a gross weight of the powder  
filling container which is filled up with the powder.

25 53. The powder filling device according to claim 45

wherein a powder feed hopper which supplies the powder to the powder fluidization hopper is provided, and a leading edge of a cylindrical part of the powder feed hopper where the powder is supplied is arranged so that the leading edge is buried in  
5 a surface portion of a powder layer of the powder fluidization hopper.

54. A funnel-like auxiliary container wherein the gas permutation unit is provided for use in the powder filling  
10 device according to claim 32.

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